Book Review

WEHNER, R. (Editor). 1972. Information processing in the visual systems of Arthropods. Springer, Berlin, New York. xi+334 pp., 263 figs., paperback. $11.50 (U.S.)

This book is the proceedings of a symposium held 6-9 March 1972 at the Department of Zoology, University of Zurich, designed to summarize structure and function of the compound eye of selected arthropods, and to apply this knowledge to the performance of the visual system in colour discrimination, pattern recognition, and other central nervous processes. Included are: preface, contents, list of participants (77), opening remarks, and 45 papers arranged in 9 parts. There is no index.

In Part 1, "Anatomy of the visual system", the structure of the ommatidium of *Musca domestica* is summarized; details of the first visual ganglion and cartridges of the lamina are given and three mechanisms of movement detection are proposed (Braitenberg). The types of neuronal elements and synapses in the optical cartridge are documented by Boschek. Strausfeld and Campos-Ortega explain the complex arrangement of feed-back and feed-forward loops. Menzel details the fine structure and pigment migrations of apposition eyes of *Formica polyctena.* The orientation of the microvilli of the eight retinula cells of the eyes of *Cataglyphis bicolor* are examined by Herrling. Expertly, Paulus describes the completely irregular, radially symmetrical, and bilaterally symmetrical rhabdoms of the eucone ommatidia of Collembola.

In Part 2, "Optics of the compound eye", Kirschfeld documents the concept of "neural superposition" via optomotor experimentation in the unfused rhabdomeres of *Musca domestica.* From rapid pigment migration studies in light adapting *Drosophila* eyes, Franceschini explains the "deep pseudopupil" seen in this and other insects. Gaussian curves are derived from continuous light intensity distributions in single fused rhabdoms of *Apis mellifera* (Eheim). Observations through the cornea of transparent mutants of *Ephestia kühniella* and *Chrysopa vulgaris,* provide Kunze with the data for superposition eye glow via pigment migrations from the edges to the centre of the facet. An inverted image of a microneedle is viewed through the cornea. Hengstenberg measures "clock-spikes" produced by a motoneuron in the subesophageal ganglion of *Musca domestica.*

"Biochemistry of visual pigments" is discussed in Part 3. Using various Insecta, and Mollusca, Hamdorf and Langer describe spectrophotometric measurements of the sequence of the absorption of a light quantum by a rhodopsin molecule through the short-lived intermediate prelumi- and lumirhodopsin to metarhodopsin, which has a longer life span and enters into a pH-dependent equilibrium with the UV-absorbing metarhodopsin II.

Part 4 summarizes experimental results postulated from, "Intensity-dependent reactions". Biophysics of the discrimination of light intensities of *Apis mellifera* (Labhart) and photopositive reactions to circular areas (Frischknecht) are described. Stationary flight thrust reduction as a function of luminance can be elicited throughout the visual field by direct stimulation of the visual elements of *Drosophila* and *Musca* (Buchner).

"Wavelength-dependent reactions" are the cohesive topic of Part 5. Burkhardt and de la Motte conducted comparative ERG studies of light sensitivity (Hymenoptera) and spectral response curves (Diptera, Mecoptera). Intensity discrimination of *Drosophila melanogaster* increases in the presence of UV light (Schuemperli). Kaiser and Liske conclude that *Apis mellifera* has no colour-specific optomotor reactions, but a highly contrast-sensitive optomotor system. Colour senses of various Insecta are determined by spectral sensitivity and wavelength discrimination (Toggweiler, Roth, Menzel).

In the sixth part, "Pattern recognition", the possibilities of correlations between neurophysiology and behaviour are investigated. Using *Apis mellifica (= A. mellifera)* and *Cataglyphis bicolor,* Wehner analyzes pattern detection and modulation measurements utilizing the light flux of a single rhabdom. Cruse researches the coefficient of the correlation function of two dimensional pattern discrimination by *Apis mellifera.* Bees cannot form a concept of "triangularity" (Anderson). Land reviews the anatomy and optics of Salticid spiders. Vision angle determination, overlap of adjoining ommatidia, and orientation of the microvilli of the rhabdoms of Collembola are documented by Schaller.

"Visual control of orientation patterns" is the theme of Part 7. In an attempt to divide the visual system into physiological constituents, Heisenberg analyzes behavioural diagnostics of *Drosophila* visual mutants including: ERG defect, optomotor response, and polarization sensitivity. Retreat along a horizontal web by *Agelena labyrinthica* Clerck is discussed by Goerner to determine the interdependency of optical and kinesthetic orientation. Idiothetic course control and visual orientation in Orthoptera are determined by statistical analysis (Mittelstaedt-Burger). Anemomenotactic orientation mechanisms are employed from 1-350 lux; astromenotactic mechanisms function beyond 350 lux (Duelli) utilizing the middle and frontal regions of the *cataglyphis bicolor* eye (Weiler & Huber). Terrestrial clues are also employed in distance measuring mechanisms (Wehner, Flatt, Burkhalter).

In Part 8, "Storage of visual information", Erber reports experiments with the learning behavious of *Apis mellifera* and the dependence parameters: "quantity and duration of reward". Masuhr and Menzel conclude that the visual system is responsible for long distance orientation.

Helverson provides a mathematical discussion of the bee's mechanism of translation of the difference between two stimuli in Part 9, "Methods of quantifying behavioural data". The curve of the relationship between "perceived stimulus" and "choice frequency" is sigmoid.

Like most symposium proceedings this is by no means a complete coverage of the visual system of Arthropoda, or even of the field suggested by the title, though it covers much beyond this. It does document recent European experimentation and emphasizes the neurophysiological advantages of the arthropod systems. Papers from North America or earlier than the mid sixties are rarely cited. Because of the diversity of specificity, the publication is saltatory. Graphs, charts, diagrams, and micrographs are numerous but some are too small. Generic and specific names are neither italicized nor underscored. These minor oversights are probably the result of the rapid publication of the text, only three months following the symposium.

Janice E. Kuster
Department of Entomology
University of Alberta
Edmonton, Alberta T6G 2E3